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Utah State University

Proposal to Establish a Thermohydraulics and Materials Properties Research Center (TMP)

MAE Faculty Participants

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1. Request

The Mechanical and Aerospace Engineering (MAE) Department within the College of Engineering at Utah State University (USU) requests authorization to establish the Thermohydraulics and Materials Properties (TMP) Research Center as a nuclear engineering research group collaboration in MAE with multidisciplinary growth potential. The Center's goal is to enhance USU's visibility, credibility, and reputation in the field and to assemble equipment and expertise as resources to secure USU's long-term position as a competitive contributor in nuclear engineering research. Dr. Heng Ban will serve as the Director and Dr. Barton Smith as the Co-Director. The Center will utilize resources and facilities in research laboratories within MAE and available generally at USU.

2. Need

USU has established itself in two primary areas of nuclear engineering research: (1) materials thermal and mechanical performance (e.g., measurement technologies and modeling capabilities for fuels and materials thermal and mechanical properties) and (2) thermal hydraulic numerical model validation (e.g., development as well as validation and verification of thermal hydraulic models for advanced nuclear power generation and safety analysis). In thermal hydraulic model validation for reactor design, USU has significant expertise in flow measurement and collaborates closely with Idaho National Laboratory (INL) researchers. In addition, the experiment-computation team at USU has demonstrated a nationally recognized ability to generate important insight into reactor safety analysis. USU has developed world class expertise in these and other areas and enjoys as close ties with INL-corresponding programs as any other US university.

The Center will allow USU to further capitalize on its growing relationships with nuclear industry research and education partners. Notwithstanding recent challenges, including federal budget crises and Fukushima, nuclear energy has remained favored within the current Administration, and funding programs concerned with nuclear energy (i.e., DOE, NRC) have fared well through federal budget trimming. TMP will pursue new technologies as the nuclear industry rises to the opportunities (e.g., small modular reactors, spent fuel storage) presented by these recent challenges. TMP will also aggressively work to enhance USU researchers' industry collaborations.

USU has grown rapidly in nuclear engineering research and enjoys support from administrators, industry partners, and INL. MAE faculty members exhibit considerable strength in several nuclear engineering areas and are engaged in funded or proposed research on nuclear fuels, thermophysical property and instrumentation, thermal hydraulics, high-temperature materials, turbulence modeling, welding, efficient high-fidelity modeling of thermo-mechanical properties of nuclear materials and structures, and other nuclear-related topics. MAE faculty members are active in the Department of Energy's (DOE) Nuclear Engineering University Programs (NEUP) and the Nuclear Regulatory Commission's (NRC) research and education programs. Supported nuclear research in MAE totals more than $3.5M, which includes research and development, faculty development, student scholarships and fellowships, and facility support. USU's President, Commercialization and Regional Development Vice President, College of Engineering Dean, and MAE faculty have all cultivated promising ties with DOE and INL officials—with potential for further growth. With this relationship building and growth in faculty expertise follows a need to further establish and expand USU's core research capability and expertise to meet research and education demand in nuclear energy—and to reinforce USU's position as a research partner and workforce incubator for the industry.

TMP Vision

- TMP will become an internationally recognized leader in the R&D of measurement tools for fuels and materials thermal and mechanical properties as well as thermal hydraulic model development and validation and verification; its faculty will be internationally recognized for scholarship in nuclear research.

TMP Mission

- TMP will develop and disseminate the knowledge and understanding of measurement science and technology in materials thermal and mechanical properties, structure-property-processing-performance relationships for nuclear materials and fuels, and development and validation and verification of thermal hydraulic models.
- TMP will seek out new research and funding opportunities along the cutting edge in nuclear engineering research and development.
- Through its faculty's expertise and collaboration with academic partners (e.g., University of Utah) TMP will educate and prepare students for nuclear engineering research and careers in the growing nuclear energy sector.

3. Institutional Impact

The proposed Center will enhance USU's reputation in nuclear engineering research, which will help attract top-tier graduate students and impact MAE's graduate enrollment. As TMP's visibility grows and as it realizes its vision and mission, more MAE undergraduate students will also likely enroll in the MAE BS program (analogous to what MAE has seen with its aerospace emphasis). In addition to elevating both enrollment and student quality, TMP's visibility will also come to play a significant role in further strengthening MAE researchers' credibility as they write increasingly competitive proposals for external funding.

The Center will be affiliated with MAE in the College of Engineering, and no changes in MAE faculty or staff will be required. The Center will utilize the existing physical facilities located in

current research laboratories. Equipment and instrumentation for the Center will be provided through contracts and grants and through industry contributions.

The Center's directors intend to join TMP's efforts with the University of Utah's Nuclear Science and Technology group to form a Utah Nuclear Engineering Consortium. Groundwork is currently being laid between research principals at the two institutions to create research and education exchanges and collaboration. The net result will be a synergistically stronger Utah-based research and education presence in the nuclear industry.

4. Finances

Figure 1 illustrates TMP's organization. No State funds are requested for the Center's establishment; the Center will focus on building from the existing base of extramural funding currently active in MAE. The Center's faculty believe its establishment has intrinsic strategic exigency. Though public opinion for nuclear may have waned recently, federal support and enthusiasm for the industry have not. As nuclear remains an integral part of the nation's energy portfolio, TMP will keep USU pro-actively engaged. TMP's establishment will create foundation on which later organizing phases can be incorporated that will pursue funding for operational expenses, equipment, and USU/INL joint appointment faculty positions.

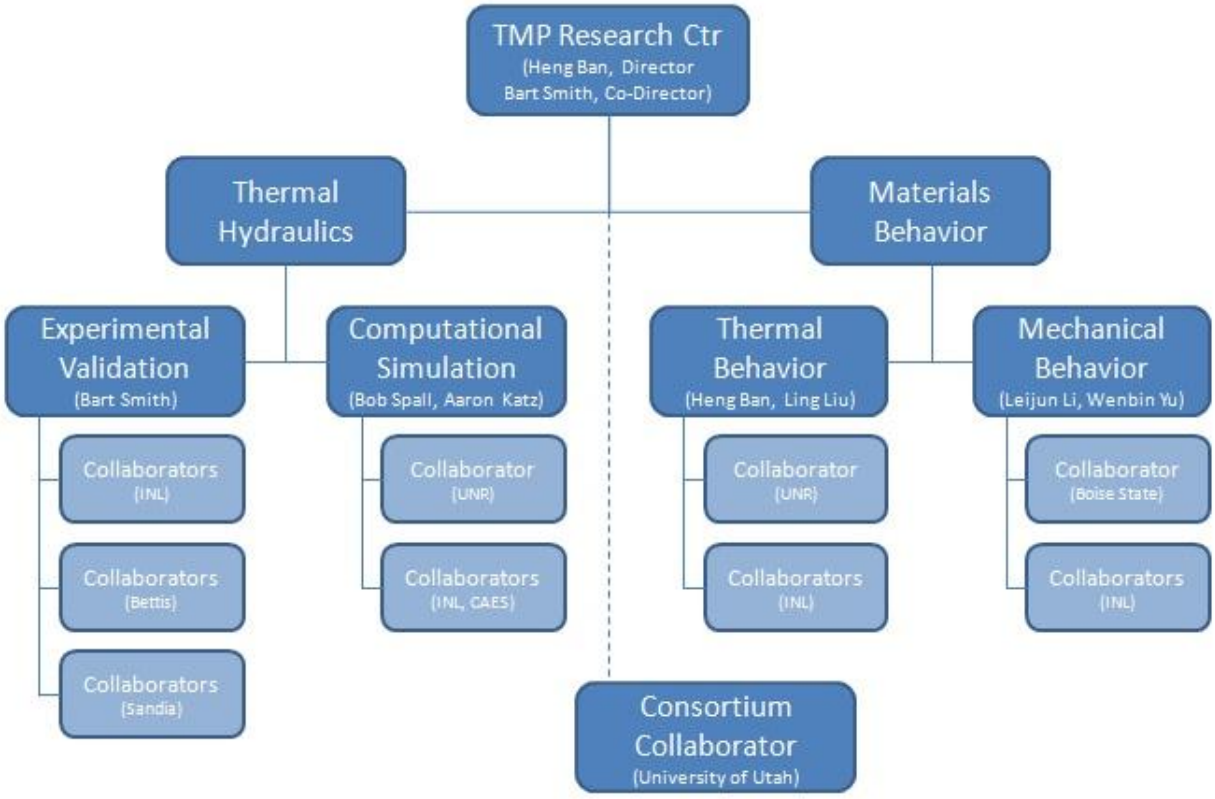

Figure 1. Thermohydraulic and Materials Processing (TMP) Research Center organization